Volume 16 October, 1930 *Number 10*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Developments in Steel Mill Lubrication

Automatic Handling of Lubricants Promotes Power Economy and Safety

PUBLISHED MONTHLY BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS
In The Steel Plant

Smelting and Refining Equipment

BLAST FURNACE EQUIPMENT

Motor Bearings	TEXACO NABOB OR ALEPH OIL
Car Wheel Journals	TEXACO BLACK OILS OR TEXACO CAR OILS
Trolley Bearings and Line Shafting	
Winter Service	TEXACO CUP GREASE NO. 1
Summer Service	TEXACO CUP GREASE NO. 3
Wire Rope	TEXACO CRATER COMPOUND NO. 1 OR NO. 0
Gears *Winter Service*	TEXACO CRATER COMPOUND NO. 1
Gears *Summer Service*	TEXACO CRATER COMPOUND NO. 2 OR NO. 5

MIXERS

Motor Bearings	TEXACO NABOB OR ALEPH OIL
Bearings of Rollers	TEXACO BLACK OILS
Roller Tracks	TEXACO BLACK OILS
Gears *Winter Service*	TEXACO CRATER COMPOUND NO. 1
Gears *Summer Service*	TEXACO CRATER COMPOUND NO. 2 OR NO. 5

BESSEMER CONVERTERS

Hydraulic Plunger Mechanisms	TEXACO AXLE GREASE GRAPHITE
Steel Cranes—Gears and Racks	
Winter Service	TEXACO CRATER COMPOUND NO. 1
Summer Service	TEXACO CRATER COMPOUND NO. 2 OR NO. 5
Bearings	TEXACO 629 OIL OR TEXACO BLACK OILS

OPEN HEARTH FURNACES

GAS PRODUCERS	
External Bearings	TEXACO BLACK OILS
Motor Bearings	TEXACO NABOB OR ALEPH OIL
Gears *Winter Service*	TEXACO CRATER COMPOUND NO. 1
Gears *Summer Service*	TEXACO CRATER COMPOUND NO. 2 OR NO. 5
FURNACES	
Door Plungers	TEXACO AXLE GREASE GRAPHITE
CHARGING MACHINES AND LADLE CRANES	
Journals	TEXACO BLACK OILS
Motor Bearings	TEXACO NABOB OR ALEPH OIL
Shaft Bearings *Winter Service*	TEXACO CUP GREASE NO. 1
Shaft Bearings *Summer Service*	TEXACO CUP GREASE NO. 3
Gears *Exposed*	TEXACO CRATER COMPOUND NO. 5
Gears *Bath Lubricated*	TEXACO CRATER COMPOUND NO. 1
INDUCED DRAFT FANS	
Shaft Bearings	TEXACO PELICAN OIL

ELECTRIC FURNACES

Motor Bearings	TEXACO NABOB OR ALEPH OIL
Gears *Winter Service*	TEXACO CRATER COMPOUND NO. 2
Gears *Summer Service*	TEXACO CRATER COMPOUND NO. 5
Miscellaneous Bearings	TEXACO BLACK OILS

STRIPPING CRANES

Bearings	TEXACO 629 OIL OR TEXACO BLACK OILS
Gears and Wire Rope	TEXACO CRATER COMPOUND NO. 1 OR NO. 2
Plungers	TEXACO CRATER COMPOUND NO. 0 OR NO. 1

INGOT AND LADLE CARS

Plain Journals	TEXACO CAR OILS
Roller Bearings	TEXACO 650T MINERAL CYLINDER OIL OR TEXACO MARFAK GREASES

POWER EQUIPMENT

BLOWING ENGINES	
Steam Cylinders	TEXACO PINNACLE CYLINDER OIL TEXACO LEADER CYLINDER OIL TEXACO 650T CYLINDER OIL
Air Cylinders or Tubs	TEXACO PELICAN OIL OR TEXACO ALTAIR OIL
EXTERNAL OR MISCELLANEOUS BEARING LUBRICATION	
Engines	TEXACO TEXOL C TEXACO NABOB OR ALEPH OIL
Motors	TEXACO NABOB OR ALEPH OIL
General Mill Bearings	TEXACO BLACK OILS
Steam Turbines	TEXACO REGAL OILS

LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published Monthly by

The Texas Company, 135 East 42nd Street, New York City

Vol. XVI — October, 1930 — No. 10

Change of Address: In reporting change of address kindly give both old and new addresses.

Developments In Steel Mill Lubrication

Automatic Handling Of Lubricants Promotes Power Economy and Safety

THE design of steel mill machinery has progressed to a remarkable extent during the past few years, by reason of the demand for more intensive, as well as more accurate production. For today the drawing of steel tubes and pipes, and the rolling of the smaller elements required for building construction and the automotive industry, has become a distinct art, where accuracy, frequently to a thousandth of an inch, is essential.

This has imposed increased requirements upon the manufacturers of steel rolling mill machinery, but they have faced the problem squarely, exercising the utmost care in this important part which they have been called upon to play, in keeping pace with the ever increasing demand for greater production, and wherever possible, a reduction in cost.

A logical consequence of this advancement has been the added cooperation of the builders of lubricating equipment, for the problems involved in steel mill lubrication have always been distinctive, due to the pressures and temperatures existing and the possibility of contamination of the lubricants. Experience has proven the value of automatic means of lubrication in meeting these problems, for however carefully a machine may be built, it cannot function effectively if its moving parts are not protected by adequate lubrication.

In the development of these means of lubrication to meet the intensive production requirements which prevail today, pressure application of both oils and greases has become virtually standardized upon.

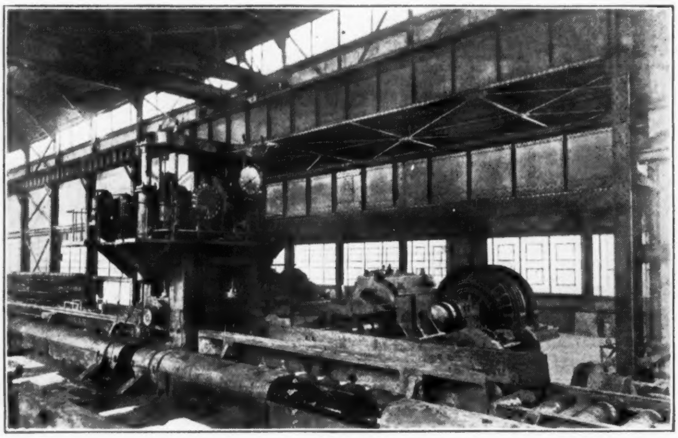
Design of modern rolling mill machinery has been the ultimate criterion in this regard, for with requirements upward of 100,000 pounds of finished product per hour per set of rolls, obviously the demand upon bearings, pinions, gears, as well as the primary drives has become greatly increased.

It is evident that these mechanisms must be positively and continuously lubricated, for only can they thereby be protected against abnormal wear, and the necessity for shutdown for repair reduced. The possibility of the occurrence of wear in the steel industry is decidedly great, for machinery as well as lubricants are constantly functioning under frequently widely varying temperature conditions in an atmosphere of scale, dust, slag, etc., and oftentimes in the presence of water.

For this reason, efforts of designing engineers have been directed toward development of sealed bearings, dust-tight gear housings, and automatic means for delivery or circulation of lubricants. This latter, however, applies more particularly to comparatively fluid oils and gear lubricants; as yet, greases and other more or less inert products have not been adapted to circulation. They may, therefore, be classified as one-time lubricants, unless bath lubrication is provided. In this case, however, no pressure is involved in their delivery to the moving parts.

This factor of pressure has proven to be one of the most important items in the maintenance of steel mill lubrication, for it has permitted the use of more fluid products, which

will more readily separate from solid non-lubricating foreign matter. Furthermore, the average oils used in any pressure circulating system lend themselves to ready purification by means of filtration or centrifugal treatment.



Courtesy of Mackintosh-Hemphill Company

Fig. 1—View of a 35 inch blooming mill, showing the relation of the rolls to the drive, and certain of the table mechanisms. In this installation the gears are bath lubricated, the oil being kept free from dirt and water by means of a circulating and filtering system.

OPERATING CONDITIONS

The essential equipment to which such means of lubrication are adaptable in the average steel mill will include the rolls, shears, saws, etc. In their operation, gears, roll neck and journal bearings, and miscellaneous guide and shaft bearings constitute the usual frictional elements. In the blooming mill, for example, the most important parts requiring efficient lubrication are the pinions and gears, roll necks and electric or hydraulic screw-downs for adjusting the rolls.

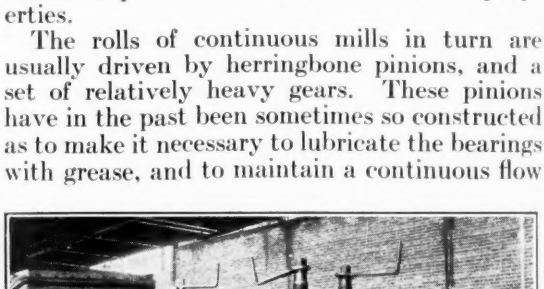
Gears and Pinions

The pinions adjacent to the roll necks in such mills will present one of the most important lubricating problems in the steel industry. This has been partially overcome in the more up-to-date mills, however, by reason of the tendency more and more to use oil tight housings, which will permit either bath lubrication or the installation of some means for pressure circulation of the lubricant. Where this latter is involved, it is practicable to use a more fluid product than where the teeth receive their lubrication by dipping in a bath of gear compound.

On the other hand, where pinions are only covered with shields which are not oil tight, or in some cases where there may not even be a bottom to the gear case, here, of course, bath lubrication is out of the question. In such instances the lubricant must be able to stick tenaciously to the teeth over the periods which intervene between applications, in order to insure a sufficiently protective film, which will withstand the terrific pounding and hammering which occur, especially when such a mill is in reverse.

In the lubrication of such elements it is also important to remember that water is often run constantly over the rolls and roll necks, for the dual purpose of cooling and blowing off scale which may be formed as the ingots, bars and billets are broken down. Some mills, in addition, blow steam directly onto the ingots during first pass through the rolls in order to remove scale more effectively. Such conditions, coupled with the extreme heat which is constantly encountered, place a most exacting requirement upon both the roll neck and gear lubricants. These must, therefore, be compounded products, inasmuch as a straight mineral lubricant will not withstand the continued washing action of hot water. The usual procedure is to compound with definite percentages of certain substances which will give the final product the desired adhesive properties.

The rolls of continuous mills in turn are usually driven by herringbone pinions, and a set of relatively heavy gears. These pinions have in the past been sometimes so constructed as to make it necessary to lubricate the bearings with grease, and to maintain a continuous flow of cooling water over them. Naturally this water will splash onto the pinions (where exposed), involving a condition and requiring a grade of lubricant as has been mentioned above in discussing the blooming mill.



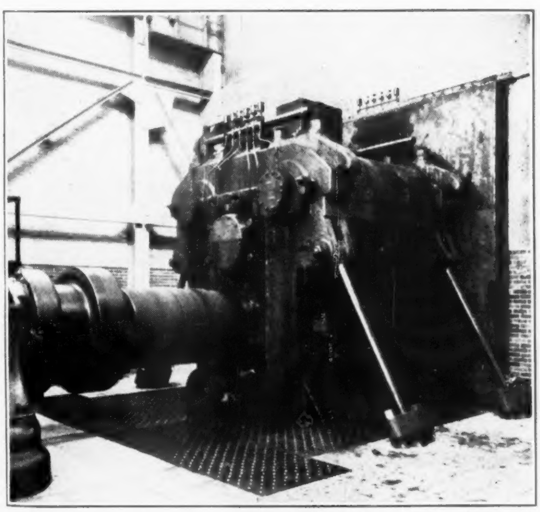
Courtesy of S. F. Bowser and Co., Inc.

Fig. 2—Showing the mill side of a hot strip mill, equipped for circulating force feed lubrication. Note the extent to which water spray is in evidence, adjacent to the edging roll. At this point in particular every effort must be made to prevent entry of water into the bearings.

Certain mills, however, may be built with oil tight gear cases and suitable shields which will permit of bath or pressure lubrication. This, of course, is the admirable condition, for the utmost of protection is afforded both the lubricant and the gear teeth.

According to the type of steel which is to be produced, it may be necessary to pass the resultant billets through another continuous mill which is set for further reductions in the size of the bars. The semi-finished product is then ready for delivery to the various finishing rolls. These latter are capable of turning out an extensive variety of rounds, squares, flats and structural shapes.

In certain of such mills of the merchant type, several sets of rolls will be dependent for their operation upon one set of pinions. It can be appreciated, therefore, that the lubrication of these latter is decidedly important. For example, if there is any undue wear of the pinion teeth, or if they mesh improperly, by the time motion has been transmitted to the end rolls any faulty operation will have become considerably exaggerated. Lost motion, in fact, may develop to such an extent as to markedly interfere with the finishing of the product. Where the final finishing rolls operate as individual units, this danger will, of course, be reduced, although it should always be considered when selecting pinion lubricants. For this class of service on open or but partly enclosed pinions the lubricant must be of relatively high viscosity and extremely adhesive, for water and heat conditions are usually quite as severe as elsewhere in the plant.

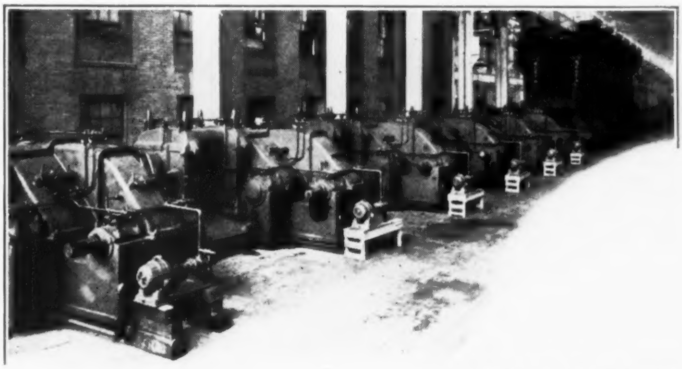


Courtesy of Youngstown Sheet and Tube Co.

Fig. 3—Showing the motor drive of a skelp mill. Note in particular the lubricators with their respective leads to the wearing parts.

Table Roll Drives

The bevel gears which drive the table rollers nearest to any type of rolling mill, also frequently operate exposed. They are, therefore, subject to water conditions, flying scale and the heat which radiates from the hot metal in its course through the plant. Here the gear lubricant is difficult to apply, in the first place, and furthermore, after it has been applied many things prevent its functioning effectively. Centrifugal force will tend to throw it off, especially where it has suffered any extensive reduction in viscosity, due to over-heating. The washing action of the water which splashes over such gears is also a detriment. In addition, excessive contamination by solid foreign matter can hardly be avoided, unless precaution is taken to guard such gears.



Courtesy of Mesta Machine Company

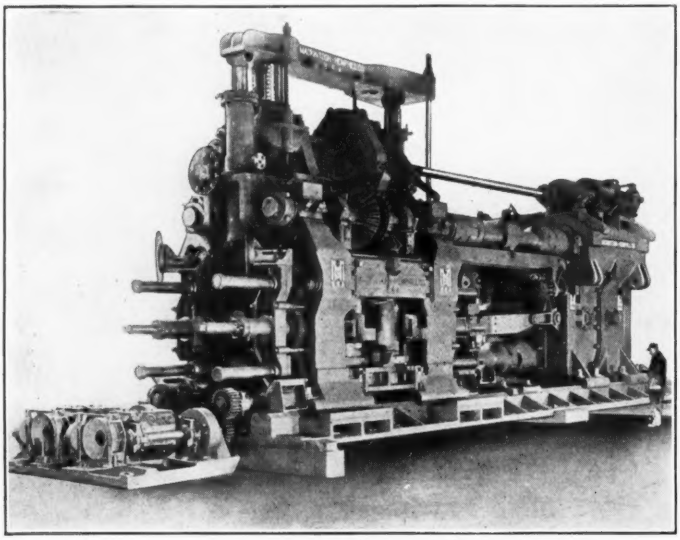
Fig. 4—Showing Mesta double reduction combination gear drives and pinion housings for four-high cold mills. The gears and pinions are fully enclosed and the lubricating system is arranged for the circulation of oil to both teeth and bearings. Proper lubrication for such equipment is highly essential in the interest of longer life and uninterrupted service.

Ultimate protection can only be attained, therefore, by frequent applications of a lubricant which has been so refined as to withstand these detrimental conditions. Usually a product having a viscosity of from 1000 to 2000 seconds Saybolt at 210 degrees Fahr., must be used according to weather and temperature conditions involved. It should be applied by pouring onto the teeth at the point of mesh while the gears are running inward.

The frequency of application will of course depend upon the amount of steel rolled through the mill and the intensity of operation. In general, over-lubrication leads but to waste, for a uniform film which covers the entire wearing surfaces is all that is necessary for their adequate protection. The application of any excess lubricant will simply mean that it will be squeezed out and probably thrown from the teeth in a short time.

Salt Also a Detriment

Plate mills present an additional detrimental condition due to the quantities of salt which are thrown on the plates during the process of rolling, and also the fact that the red hot plates pass directly over the bearings and gears of the table rollers. The purpose of salting is to remove the scale. Oftentimes, water is also sprayed on the rolls in addition. These factors, coupled with flying scale and dust which are driven with considerable force when the hot gases explode, tend to destroy any lubricant used on the roll necks, table roller bearings and gears. Types of mineral gear compounds as mentioned above have been found to withstand these detrimental elements quite satisfactorily provided they are applied at frequent intervals and in sufficient quantities.



Courtesy of Mackintosh-Hemphill Company

Fig. 5—A 32 x 46 two-high universal mill, showing in particular the gearing arrangement and the relative size of the entire installation.

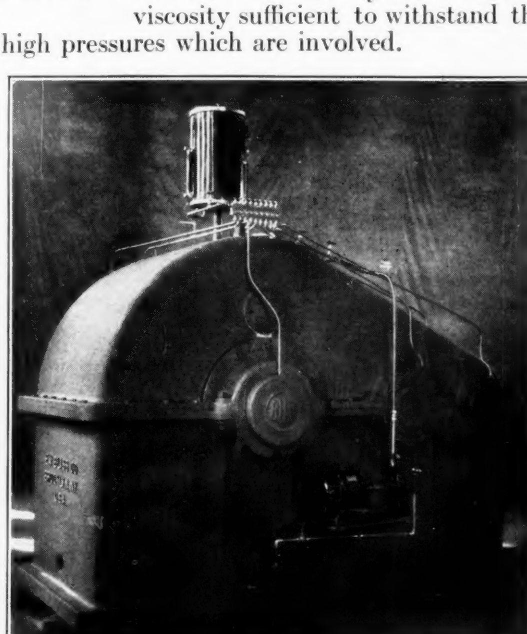
Plate mills may be either of the two high or three high type, being driven by a corresponding set of herring-bone pinions. In many cases these driving pinions will be located in open housings, so adjacent to the mills that it is relatively impossible to protect them in any other way than by means of effective lubrication. Here an additional property which the gear lubricant must possess is an ability to resist being thinned out by the oil which is used on the pinion bearings, inasmuch as a good deal of this latter will often work out and onto the gear teeth, especially in older types of mills.

Roll Necks

Roll necks must be lubricated with a specially compounded roll neck grease that will not carbonize nor wash off when in contact with the water which is so often run over them to keep them cool. Lubricants used on such roll necks are termed cold neck greases. In general, they are tallow-mineral oil compounds, oftentimes being so prepared as to emulsify on contact with water. Frequently, however, water is not used or even where it is, the necks may run so hot as to melt down a cold neck grease. In such cases, a hot neck grease of high melting point must be substituted even though added friction and wear may be developed.

The Screw-Down

As its name implies, this consists of two long screws driven by electric or hydraulic power; its purpose is to raise or lower the rolls as necessary. While it is not subject to water conditions, nevertheless it will also receive considerable heat and perhaps its share of flying scale and dust. Therefore, it too requires careful lubrication. These screws should be lubricated periodically with a fairly heavy grade of straight mineral steam refined cylinder oil of a viscosity sufficient to withstand the high pressures which are involved.



Courtesy of E. W. Bliss Company

Fig. 6—External view of a Bliss mill, showing in particular means for automatic lubrication, including the overhead tank, the sight feed controls and the oil pump.

PRESSURE AS APPLIED TO LUBRICATION

Transition in Design

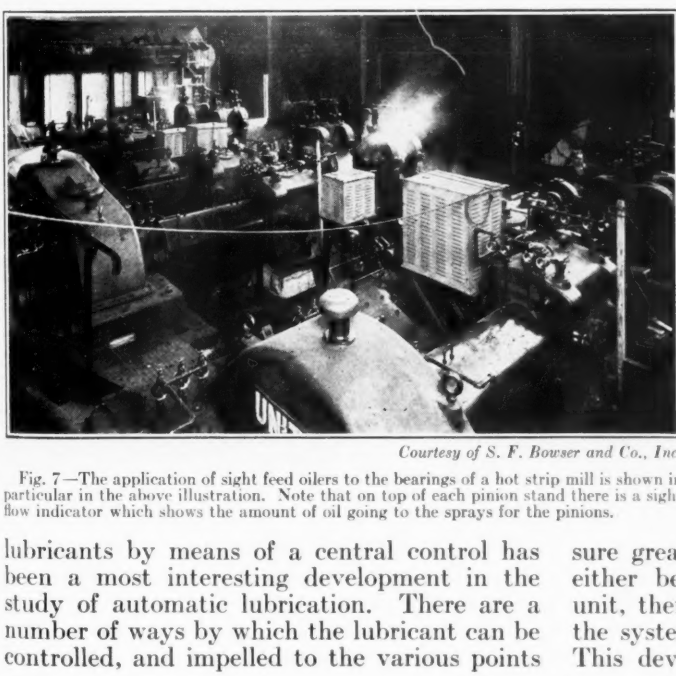
The earlier developments of pressure lubrication in the steel mill were more or less con-

fined to unit devices, especially where greases were involved, although the mechanical force feed oiler could be adapted to serve a number of wearing parts. This latter device, however, is more suited to prime moving elements, such as blooming mill engines and other steam drives; its capacity is somewhat limited for the requirements of rolling mill equipment.

The pressure grease cup, in turn, proved its adaptability only to parts which were accessible. Furthermore, it was also of limited capacity. The study of means for centralized pressure grease lubrication, therefore, became a logical consequence, along with the design of somewhat similar systems for the application of more fluid lubricants. Today, as a result, lubrication by means of centralized pressure can involve grease or oil according to the design of the lubricating system. The features of any such means of lubrication include positive delivery of lubricant under adequate pressure to insure maintenance of a sufficient film between the bearing surfaces, the exclusion of non-lubricating foreign matter, but little labor to operate, decided economy of lubricants and a minimum of hazard in handling or filling.

Means of Grease Lubrication

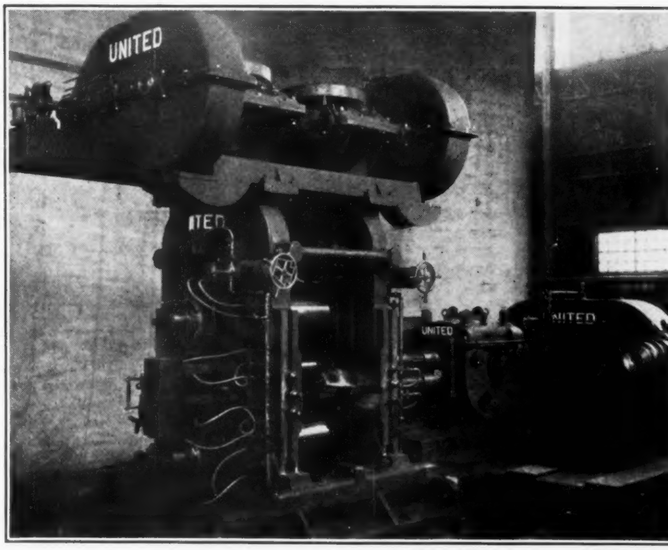
The distribution of comparatively heavy lubricants by means of a central control has been a most interesting development in the study of automatic lubrication. There are a number of ways by which the lubricant can be controlled, and impelled to the various points of delivery. In all, however, power in some form or other must be involved.



Courtesy of S. F. Bowser and Co., Inc.

Fig. 7—The application of sight feed oilers to the bearings of a hot strip mill is shown in particular in the above illustration. Note that on top of each pinion stand there is a sight flow indicator which shows the amount of oil going to the sprays for the pinions.

Where positive piston displacement types of metering valves are employed at each point to be lubricated, hydraulic power has been found to be especially adaptable, as a means of valve control. In such a system either one or two lubricant supply lines can be connected to each valve according to the nature of the service. For heavy duty machinery, such as is encountered in the steel mill, dual lines are employed. Here one line serves to load the respective valves periodically with the right amount of lubricant, the other functioning as the medium for discharging the latter to the bearings.



Courtesy of United Engineering and Foundry Co.

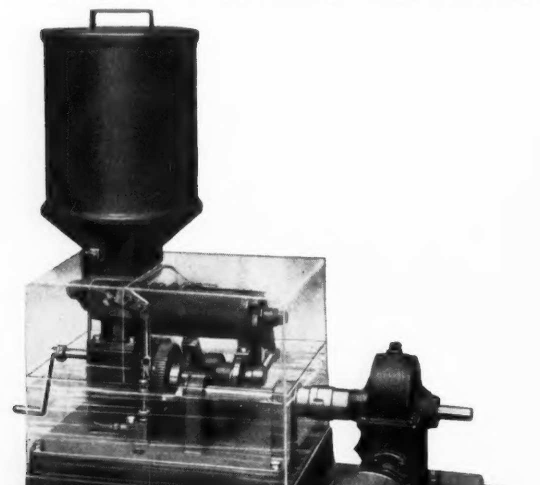
Fig. 8—Showing a United four-high mill, equipped for pressure grease lubrication.

In contrast to the above, are those systems involving electric power or compressed air. Certain of these are designed to eliminate the necessity for springs, check valves or restricted port openings. By virtue of the resultant constant pressure which is exerted upon the lubricant, the development of air pockets which might interrupt positive flow, is eliminated.

The Pressure Gun

The pressure gun has been an important adjunct in the operation of certain types of centralized pressure greasing systems. In its usage it can either be designed as a directly connected unit, thereby becoming an integral part of the system, or a portable gun can be used. This device is of decided value as a general

piece of plant lubricating equipment, inasmuch as it can be used quite as effectively in connection with individual lubricators as with a centralized system. It can furthermore be used with the spring type of cup with equal dependability.



Courtesy of Hills-McCanna Company

Fig. 9—Details of an Anderson mill type grease pump, showing, in phantom, the constructional details. All moving parts run in an oil bath.

Spring Type Grease Cups

The combination of the pressure grease gun plus the spring type cup is decidedly advantageous for the lubrication of inaccessible or hazardously located bearings on many types of machinery. As a general rule, by using a spring of particular tension plus a suitable orifice, flow of grease therefrom can be very accurately controlled. Furthermore, it can be noted by observation of the indicator with which such lubricators are usually equipped.

Filling of such a cup is a simple and cleanly matter. It merely amounts to attaching the pressure gun to the fitting located in the base of the cup. There is no necessity for removal of the cover, as may be true with those cups which are more strictly of the hand pressure type. In consequence there is more positive assurance that the grease charge will not become contaminated through possible entry of dust or dirt.

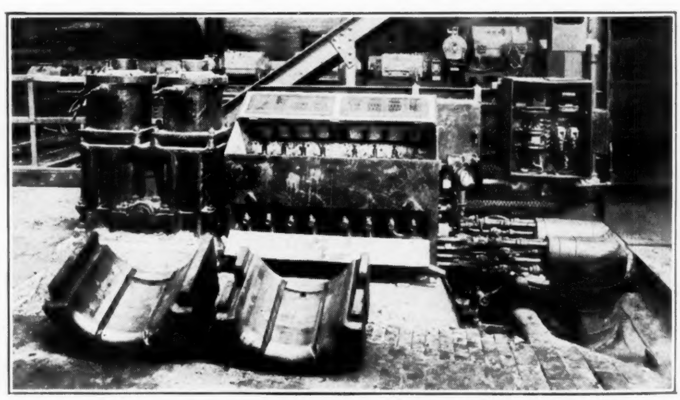
The next step is to shoot grease into the cup until the indicator rises to its full height to show that the cup has been completely filled.

The initial pressure for such filling may be obtained by use of compressed air, electric power, or simply hand or foot power, according to the type of gun and the pressure desired. The former develop considerably higher pressures than the latter. Of course, where a relatively simple hand pressure grease gun is used, the impression may be gained that this should be classified with the hand pressure or screw-down type of cup. We must, however, remember that hand pressure as applied to a grease gun does not react directly on the bearing; it must first be converted to mechanical energy by doing work in compressing the spring in the grease cup. From this point on lubrication is automatically maintained by the mechanical action of the spring upon the adjacent plunger which bears upon the grease charge to force it through the bearing.

The Power Driven Grease Lubricator

In certain phases of operation, however, grease lubrication under considerably higher pressures than can be attained through the average spring type of cup will be essential. Here the question of positive and complete cleaning of bearing clearance spaces and oil grooves (where included) prior to re-lubrication will be of primary importance, especially where conditions of operation may be conducive to entry and accumulation of dust, dirt or other non-lubricating foreign matter.

Automatic delivery of lubricant is, in such cases, dependent upon the pressure available.



Courtesy of The J. V. Walsh Sales Corp.

Fig. 10—View of a Roberts centralized system for grease lubrication, applicable to steel mill service. Above is shown a sixteen valve unit, electrically operated, serving a 28 inch structural mill.

In the spring type cup the latter is normally lower than where direct application of grease by means of a pressure gun is employed.

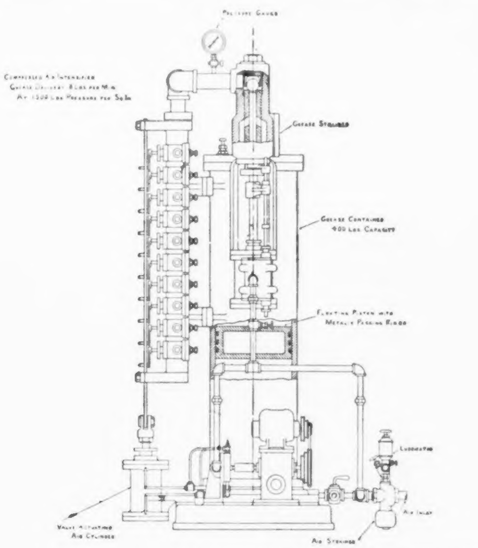
On the other hand, use of the pressure gun in virtually any form requires a certain amount

of manual handling. The gun itself must be moved about, flexible hose must be handled, fittings must be wiped clean before attachment of the hose or gun connection, and finally the gun must be put into operation. All this requires time, care and good judgment. The latter is especially essential in determining when a bearing has been completely relubricated.

For this reason, attention has been directed to concentration of pressure gun fittings at a central panel or point of control. This has been accomplished with signal success, until today it can be safely stated that not only in the steel industry, but also in other phases of production where heavy duty machinery is involved, centralized pressure grease lubrication is a practicable and comparatively economical procedure. Furthermore, the extent to which it enables reduction of hazard by concentrating lubrication in a safe location, renders it worthy of careful study.

Clearing of Bearings

In many types of plain bearings, forcing in grease under pressure (as already mentioned) serves as a very effective means of forcing out all old grease and any dirt contained therein. Judgment is necessary, however, in determin-

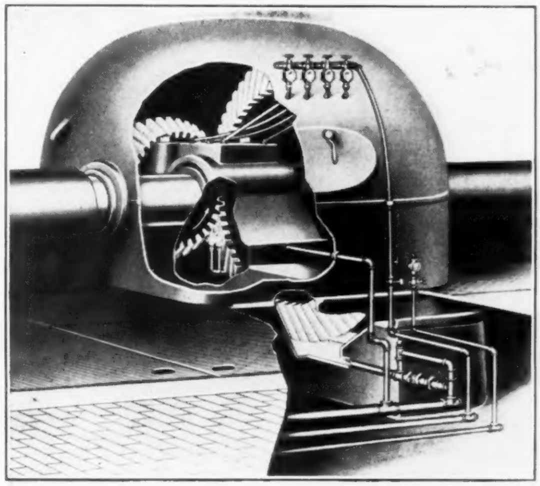


Courtesy of The J. V. Walsh Sales Corp.

Fig. 11—Showing constructional details of a Roberts lubrication outfit. Note the capacity of the grease container, the strainer, and the valve operating mechanism. In this device the grease is always under positive pressure and so contained that there is comparatively no possibility of contamination.

ing when this has been completely accomplished and when to shut off the pressure.

If properly done, such a method of lubrication is decidedly economical. But if the operator is careless, unobservant, or continues lubrication beyond the necessary extent, he will not only waste grease, but may also cause development of a sloppy condition around the bearings. A slight bulge of fresh grease at a bearing end will usually indicate that complete re-lubrication has been accomplished with the least waste of product.



Courtesy of S. F. Bowser and Co., Inc.

Fig. 12—Illustrating in detail the manner in which pressure circulation of oil can be applied to a set of gears, pinions and their respective bearings. Note in particular the spray of oil applied to the gears at the point of mesh. This may be applied either above or below, according to the direction of rotation. The washing action of the oil not only keeps the teeth clean and cool but also performs the same function for the bearings.

Types Involved

Pressure lubricators have been mentioned as being of either the hand or power type. For the use of the individual machine operator the former is perhaps the most suitable device, due to its ability to operate by means of hand or foot pressure.

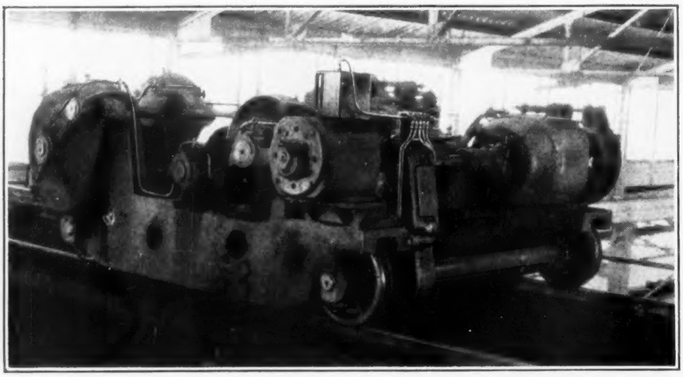
Grease guns of the hand pressure type will usually be capable of developing several thousand pounds pressure per square inch. They are practicable either with or without hose connections, according to the type of fitting they are designed for, or the location of the part to be lubricated.

Pressure can be applied either before or after attachment of the gun to the fitting. A frequent method of developing pressure is to force down a suitable plunger by means of a threaded stem which screws into a bushing in the head of the gun. Another type of gun involves pumping action by means of the handle and a suitable pressure retaining device.

According to the design, where pressure is to be developed before attachment of the gun to the fitting, a suitable check valve must be installed in the tip. In certain guns the act of attachment opens this valve and automatically permits lubricant to be forced in the bearing.

The purpose of designing rigid connection

guns with check valves is to eliminate the necessity of relieving the pressure before detaching the gun from the fitting and to enable pressure to be raised before attachment, to overcome the possibility of twisting off the fitting, which might otherwise occur. The direct or swivel jointed connection also does away with the possibility of leaks in the flexible hose.



Courtesy of Rivet Lathe & Grinder Corp., Blanchard Lubrication Division

Fig. 13—Showing a Blanchard pulsating system for oil supply, installed on a trolley mechanism of a travelling crane. This means of lubrication is particularly advantageous in that it functions irrespective of the direction of operation, starting and stopping with the movement of the machine, obviating the necessity for an attendant to climb round for the purpose of re-lubrication.

These factors are especially important where bearings are to be "started" involving the expulsion of grease which has been allowed to remain too long in the grooves or clearance spaces and consequently become gummed, caked and mixed with dirt.

In steel mill service, however, the hand pressure gun is frequently supplanted by the mechanical or power lubricator of considerably greater grease capacity. In general, such lubricators are capable of holding 50 pounds of grease or more.

The smaller capacity guns are chiefly of the hand service type; that is, after pressure is developed grease is discharged by the operation of a pump handle or lever.

A ball or check valve at the base of the pump automatically closes at the end of each stroke to retain all pressure that may have been built up. To insure efficient operation this check valve must, of course, be kept clean. It should, therefore, be inspected at frequent intervals.

In such lubricators pressures of from 1000 pounds upward are readily developed. These pressures are sufficient to effectively handle the usual grades of grease which are applicable to steel mill service.

The electric or pneumatic compressor has proved to be very suitable for the handling of heavier and more viscous grades of lubricants, however. Such lubricators are usually of higher capacity than the hand service type, in certain cases holding as much as 400 pounds of lubricant. In this latter capacity a multi-lead discharge manifold is frequently installed to enable the lubrication of a number of points simultaneously. Such compressors can be either electrically driven, or designed to take their air from an adjacent compressed air line. In other respects, however, the principles of the power lubricator or compressor are much the same as those involved in the hand service type.

PRESSURE APPLICATION OF GEAR LUBRICANTS

It will also be interesting to note that automatic means for pressure application of gear lubricants has been developed for the collective lubrication of reduction gears.

In the course of lubrication of gearing, especially on many types of industrial machinery, the matter of assuring positive, cleanly and economical application of lubricants to the gear teeth may become a problem. This will be particularly true where gears are exposed, or but partly enclosed, for in such installations the tendency of lubricants to be thrown off by the action of centrifugal force must be guarded against. As a result, it is important to study the rotation of the gears. In other words, certain types of lubricants, such as greases, are only applicable to down-meshing gears with any degree of success. With up-meshing gears the necessity for application of such products at the top will result in their being thrown off during subsequent rotation due to centrifugal force.

This will, however, depend upon the viscosity and adhesive characteristics of any lubricant. Where application or re-lubrication is to be done by hand, these characteristics must be given very careful consideration, otherwise not only may the gear teeth suffer, but also a sloppy condition may prevail, due to dripping or throwing off of the lubricant.

For this reason gears are housed or guarded wherever practicable. Furthermore, means for automatic lubrication have been extensively studied by machinery builders. The simplest way to attain this is, of course, to enclose at least the lowermost parts of the gears in an oil-tight housing, and provide for bath lubrication.

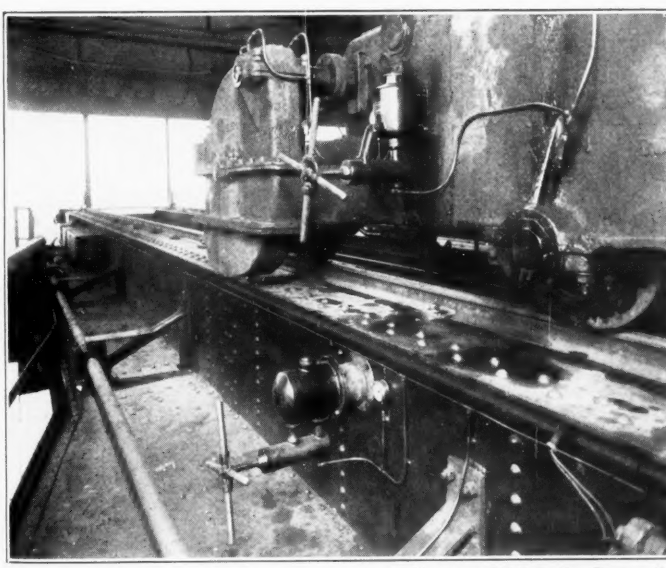
This, however, does not obviate the possibility of more or less of an excess of lubricant being carried out from the bath to be perhaps thrown off from the teeth at some tangent during completion of rotation of the gear. This will be especially possible if too light a product is being used, or if it is not sufficiently

adhesive to stick to the wearing surfaces of the gears.

By resorting to some means of delivering a gear lubricant to the teeth as they pass into mesh, in more nearly the right amount to maintain lubrication, the above can frequently be checked. Pressure has been developed as being a very practicable means of accomplishing this. It may be mechanical, and dependent upon the operation of the machine itself; or the lubricating system may function independently, being power operated.

The adaptation of mechanical drive for the larger, heavier duty types of rolling mill gearing will frequently not be practicable. Here the intensity of the service and the volume of oil to be handled will call for the use of independently operated power driven pumps. Either steam or electricity can be employed according to the facilities available and the design of the system of lubrication.

Multiple lubrication, by means of compressed air power, has also been suggested, especially for exposed gears. In such a system specially designed lubricating pumps equipped with removable lubricant containers are planned for at each point of lubrication. These pumps are all connected to a common air control device, which in turn is supplied with proper air supply and exhaust connections. Compressed air can be taken from a suitable

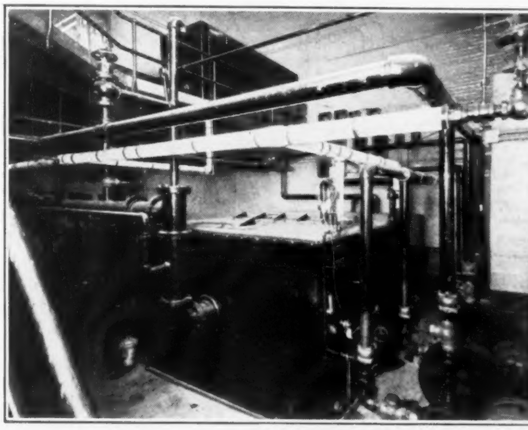


Courtesy of Lubricating Devices, Inc.

Fig. 14—Side view of a single hoist bridge crane, equipped for pressure grease lubrication. Note in particular the operating mechanism and the piping to the respective bearings.

source adjacent to the machine itself or from an air line elsewhere in the plant.

At regular and controlled intervals air is applied via the control mechanism, simultaneously to all the lubricator pumps in the system, a predetermined supply of lubricant being subsequently delivered to each set of gears at their point of mesh. The gear shaft bearings may be similarly lubricated. In view of the fact that the air control mechanism is



Courtesy of S. F. Bowser and Co., Inc.

Fig. 15—Details of an oil cellar, showing the equipment involved in a pressure circulating system of automatic lubrication. Note the gravity type of filter on the balcony above, as well as the general lay out of the storage tank, piping and pumps.

driven directly from the machine to be lubricated, through suitable belt or chain connection, lubrication is only carried out while the latter is in operation.

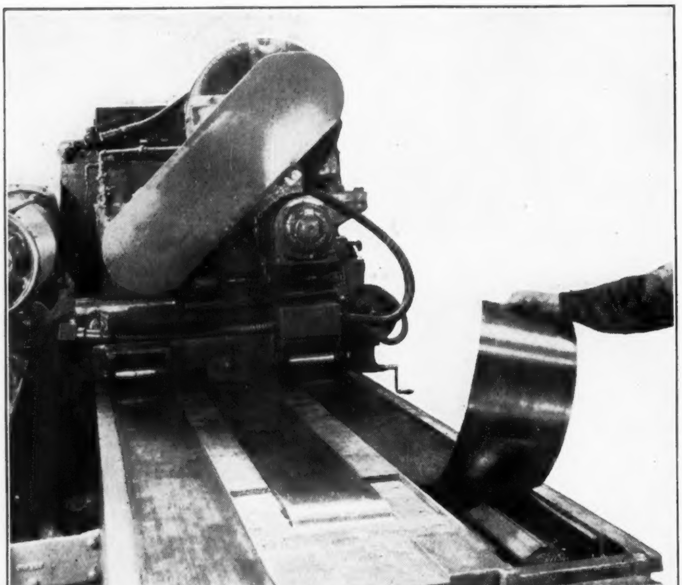
In such a system comparatively heavy gear lubricants can be used, of a viscosity as high as 1000 seconds Saybolt at 210 degrees Fahr. Such products, if of straight mineral nature, will have a high degree of adhesiveness, and but a very small quantity will be required to maintain an adequate protective lubricating film. Where application or renewal is automatically carried out in measured quantities, the possibility of dripping or accumulation to sufficient extent to throw off, should be decidedly reduced.

PRESSURE CIRCULATION

Pressure circulation of the more fluid oils to certain types of steel mill bearings and gears subjected to intensive duty, and frequently high temperatures, has been studied in considerable detail for several years. A variety of combinations have been worked out, ranging in simplicity from the unit type of gravity feed system to those multiple power devices whereby an entire series of rolling mills is served by oil under constant pressure.

There is a difference of opinion as to the

extent to which entirely automatic operation should be approached in this regard. Certain authorities feel that the unit idea whereby each mill is designed as an individually lubricated unit, will reduce the possibility of extended difficulties should faulty lubrication of any particular part develop. To adhere to simplicity, gravity circulation of oil in such systems is frequently preferred, with the thought that it will reduce intricacy in construction and the necessity for costly automatic controls.



Courtesy of Farrel-Birmingham Co.

Fig. 16—View of a steel mill roll grinder. Note in particular the inverted "V" ways. These are lubricated by pressure through oil holes located at the apex of the "V". During the passage of the carriage the oil is spread via the trough at the top of the way, to serve not only as a lubricant, but also to wash out any non-lubricating foreign matter. Entry of this latter is largely prevented by the flexible guards, one of which is being held up. There is also a guard over the center drive mechanism to protect the lubrication of this latter.

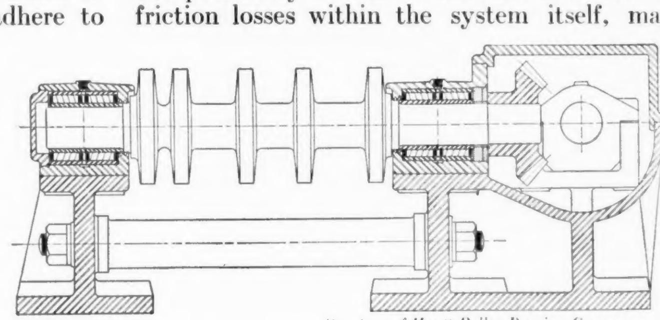
Gravity circulation, on the other hand, is limited in regard to the amount of pressure available. Where this may be low, due to plant limitations, for example, it may affect the viscosity of the oil which should be used. Normally with increase in pressure, the viscosity can be somewhat reduced, the volume involved and pressure under which the oil is applied to the gear teeth or bearings, compensating for the reduction in body of the lubricating film.

The Importance of Fluidity

In steel mill practice, there are certain limits, however, which will control the viscosity as as well as the pressure. Primarily, the pour test must be considered, for in cold weather or low temperature starting of a mill, this will influence the rate at which the oil will return to the settling tanks. Obviously, if the oil should become too sluggish at any time, flow off from a pinion housing or bearing might be impaired to develop backing up of the oil in the system. Should any bearings not be properly sealed, this oil might find its way to the exterior of the case to develop a sloppy condition on the operating floor.

It is also well to remember that decrease in fluidity of an oil due to an originally too high viscosity or pour test, may develop marked increase in power consumption. This would prevail throughout the system, for not only would the circulating or oil delivery pumps be called upon to do extra work, but also the mill drives themselves might feel the extra duty demanded due to the increase in internal friction within the lubricating films.

The more automatic such a system becomes, the more must these factors of pour test and relative fluidity be considered, for the normally extensive piping layouts and the possibility for the occurrence of abnormal friction losses within the system itself, may cause reduction in oil flow to a sufficient degree to require severe overloading of the pumps in order to maintain the requisite oil level in the supply tanks, or the desired flow to the bearings, gears, or pinions.



Courtesy of Hyatt Roller Bearing Company

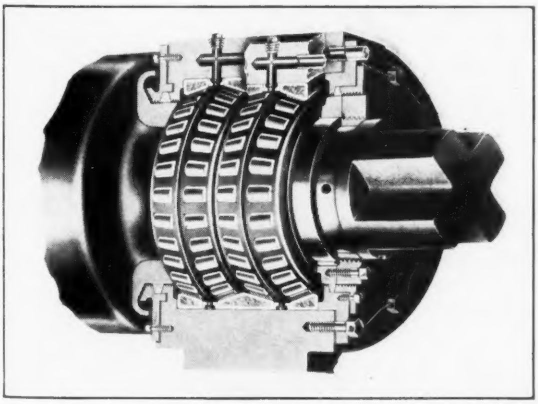
Fig. 17—Sectional view of a plate mill table design, equipped with flexible roller bearings.

Water Contamination an Important Item

In the adaptation of pressure circulation lubrication to steel rolling mill, it is essential to remember that water contamination must be guarded against at all times. This is essentially a problem which should be forestalled by the designing engineer, in the realization that water contamination to any excess may seriously impair the lubricating ability of any good oil. The prevention of entry of water into a circulating lubrication system in an existing mill, however, may require the added cooperation of the master mechanic, the engineers who installed the means of lubrication, as well as the lubricating engineer. There should never by any quibbling as to assumption of responsibility for such a condition, nor should it be allowed to continue for any length of time, for inevitably it will lead to increased trouble, with the possible necessity for shutdown.

The use of water spray in steel mill practice is especially essential on heavy duty mills, where it is desired to eliminate scale formations. It is surprising the extent to which this water, after passing over the mill and hot metal, will find its way to the bearings and drives, however carefully they may be constructed. Furthermore, at a temperature of very nearly the boiling point, water will have a decided tendency to actually "cook" any oil with which it comes in contact, to cause formation of permanent emulsions which may be very difficult to break. The use of suitable traps in settling tanks will aid materially in removing water from such a system.

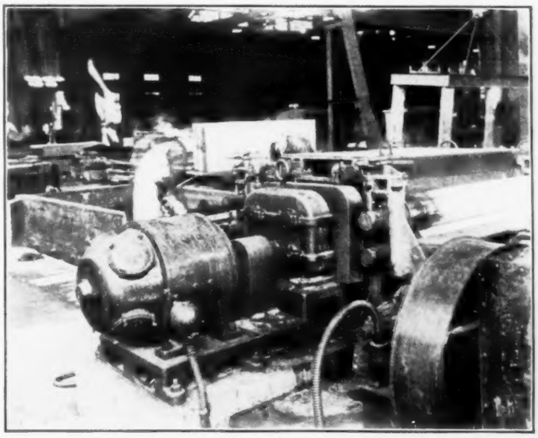
Proper sealing of all points wherein water



Courtesy of The Timken Roller Bearing Co.

Fig. 18—Showing typical application of Timken tapered roller bearings to the neck of a steel mill roll.

may gain entry into such a lubricating system will be excellent insurance against this possibility of contamination. It can be accomplished by caulking surface joints with oakum, and covering with molten lead. In the case of bearings, however, attention should be directed to their original design, in order to provide for some recognized method of sealing, which, however, will not impair in any way the free rotation of the shafts.



Courtesy of S. K. F. Industries, Inc.

Fig. 19—Showing a heavy duty Reliance adjustable speed motor. This is used on a steel scrubbing machine. In view of exposure to splashing acid, dirt and live steam, the entire motor must be entirely water tight. The use of ball bearings permits such construction of the bearing housing.

REDUCTION OF HAZARD

All this attention to development of more automatic means of lubrication has naturally worked out in the interest of decreasing hazard in the operation of steel mill machinery.

Hazard is a most important matter in steel mill lubrication. The massive nature of the machinery, the class of labor frequently employed, conditions of intensive operation, and the presence of hot metal and flying scale, all of which are a necessity by reason of the nature of the materials handled, combine to present hazard at all times. This will be all the more true where means of lubrication are employed which are located so adjacent to parts such as roll pinions, etc., as to require the operator to approach these too closely when adjustment is made.

By employing means of centralized lubrication, however, the human factor in the maintenance of effective lubrication is decidedly reduced, not only by virtue of the more positive degree to which oils and greases are applied, but also by elimination of the apprehension which would otherwise exist in an operator's mind were he to be compelled to incur danger periodically in attending to individual lubricating equipment.

THE LUBRICATING ENGINEER

In view of the fact that the average purchasing executive will be comparatively unfamiliar with the operating conditions in his mill, and the duty which will be required of lubricants, he

should always take the lubricating engineer into consultation. In fact, purchase of lubricants should be the subject of conference wherever there may be operating problems or intricate machinery involved.

The lubricating engineer should be a specialist in the selection, handling and application of steel mill lubricants. He should have an intimate knowledge of the principles of refining and compounding of lubricants for specific purposes, and complete familiarity with systems and means of lubrication.

While it is usually possible to call in such a specialist from any reputable manufacturer of lubricants, certain steel mills will prefer to retain their own talent in this regard, or enlist the advice of a consultant.

Duties of the Plant Lubricating Engineer

As a general rule the plant lubricating engineer is a decided asset wherever a considerable volume of machinery is involved, and where impaired lubrication in any unit might seriously disrupt a production schedule.

In such mills the plant lubricating engineer should have direct supervision of the storage facilities and the means of application of all lubricants. He should prepare oiling schedules, dictate periods for flushing and cleaning of lubricating systems, instruct operators as to the advantages to be derived from careful lubrication of their machinery, and cooperate with the chief engineer and master mechanic in the installation of new equipment or maintenance of existing units, wherever the matter of friction reduction may be involved.

An added advantage is that such an authority as a member of plant personnel can check up on the specifications of any lubricant which may be offered to the purchasing department, or he can prepare his own, based on test data which he has developed according to the operating conditions involved. In many cases this will be positive assurance that the right kind of lubricants will be obtained and that effective lubrication and maximum reduction of friction will be accomplished.

Lubricating Engineering Service

In some mills, on the other hand, the volume or nature of the machinery involved will not warrant the employment of such a specialist, or perhaps whoever may have this work in hand will not have the requisite education or experience in matters of mechanical engineering and lubrication.

For such concerns, lubricating engineering service as offered by the manufacturer of lubricants will be a decided asset. It is absolutely essential, however, that such service be backed by a reputable company. To seek advice from any one who does not have due regard for the title, "Lubricating Engineer" might be hazardous in that there would be no assurance that his lubrication recommendations would be dependable.

Lubrication engineering service of repute is one of the greatest assets available to the operator of mechanical equipment. It affords an especially economical way of availing oneself of expert technical advice in regard to solution of problems of lubrication and the determination of lubricants capable of maintaining operation in the most efficient manner.

Furthermore, the lubricating engineer who represents a reputable manufacturer of lubricants will as a rule be far more conversant with the many variables that must be considered, than he who is in the employ of any specific industrial concern. This is quite natural, for the latter has far less opportunity to study and familiarize himself with lubrication as applied to industry as a whole.

The oil company engineer, on the other hand, is in daily intimate contact with this phase of operation and production. He can approach the steel mill executive and quote experience with high temperature lubrication problems in the cement plant, for example, quite as readily as he can discuss the matter of low carbon content to the Diesel engine operator, and cite its advantages as developed for air compressor service.

In other words, he is so broadly trained by actual experience that his advice should never be overlooked. He can show the dollars to be saved in year-round power consumption and machine maintenance costs, where otherwise the pennies in cost per gallon of lubricating oils might be the sole consideration of the purchase.

* * * *

ERRATA

In the September issue of "LUBRICATION" the captions applied to Figures 13 and 15 should be reversed, Figure 13 showing a silent chain casing, and Figure 15 a socket pillow block. We extend our regrets to The Link-Belt Company for this error.

Printed in U. S. A. by
Edgar C. Ruwe Co., Inc.
72 Washington St., N. Y. C.